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ABSORPTION OF MISCELLANEOUS LIQUID WASTES ON SAWDUST

Report No. 90-206-K
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ABSTRACT

The absorption on to sawdust of Freon dry cleaning sludge and liquid waste generated during a super-compactor campaign was investigated. Absorption is required to store or incinerate the liquids. The super-compactor waste consisting of an aqueous and an oily stream was characterized; based on the characterization, the aqueous effluent can be directed to the Active Liquid Waste Treatment System at Bruce A while the oily effluent requires to be stored or incinerated. The capacity of sawdust for this liquid and the dry cleaning sludge was determined and operational parameters for performing the absorption were assessed. Sawdust appears to be adequate for feeding the liquids in to the incinerator; however, its poor capacity may make its usage for extended storage of the liquids uneconomical.

job	file	date	report no.
32-155-462	836.29	November 16, 1990	90-206-K

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EXECUTIVE SUMMARY

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The absorption of two liquid waste streams on sawdust was examined in this study. The first waste stream consisted of effluent from a super-compactor campaign conducted at BNPDS in late 1988 while the second waste stream, namely, freon sludge is a routine waste arising (10 m^3 annually) from dry cleaning operations at Bruce. Routine generation of super-compactor effluent (6-20 m^3/yr) will occur in the near future if the planned purchase of a super-compactor materialises.

Based on earlier work, sawdust was considered to be a suitable host for absorbing supercompactor effluent and as an alternative to corn husks (Toxi-Dry) presently being used for the dry cleaning sludge. Its capacity for both liquids was determined in this study; as well, appropriate means for absorbing the liquids were investigated. A radio-chemical characterization of the super-compactor effluent was also performed. The dry cleaning sludge has previously been characterized.

The super-compactor effluent consisted of an aqueous and an oily waste stream. The low solids loading combined with the absence of any significant content of toxic metals suggests that the aqueous effluent can be routed to the Active Liquid Waste Treatment System at Bruce A. The oily effluent would, however, require to be suitably immobilized and thereafter incinerated or stored.

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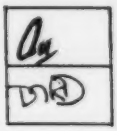
Absorption capacity of the sawdust for the super-compactor oil was determined to be 1.9 g oil/g or equivalently 0.42 g oil/mL of sawdust. The capacity for the freon sludge was somewhat lower: 1.5 g oil/g or 0.33 g/ml.

Options for contacting the oil with the sawdust were explored. The oil may either be distributed on top of the sawdust or be fed at the bottom using tubes inserted through the bed of sawdust thus causing the liquid to fill up from the bottom. Spillage could occur in the first option due to the rate of filling exceeding the rate of absorption. The second option was thus preferred. However, the introduction of the oil from the bottom up often caused the uppermost layer of the sawdust to remain dry with possibly a pool of unsoaked liquid remaining at the bottom. In such cases, inversion of the sealed containers appeared to adequately redistribute the pool of liquid. Although flow rate would be an important process variable in the first option, it is of no consequence in the second option and this was verified.

Overall, sawdust appears to be adequate as an absorbent for feeding both super-compactor effluent and freon sludge in to the incinerator. However, due to its poor capacity compared with other media such as Dow imbiber beads which can absorb several times their own volume of oil, its use as an absorber for extended storage of the liquids may not be economical.



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To: Mr. D.W. Souther
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ABSORPTION OF MISCELLANEOUS LIQUID WASTES ON SAWDUST

A. Husain

1.0 INTRODUCTION AND BACKGROUND

The existing radioactive incinerator does not permit the direct incineration of liquids. Hence, liquid waste streams such as freon dry cleaning sludge are first absorbed on a solid media prior to incineration. This practice may change when the existing facility is phased out; the new incinerator will likely be capable of accepting liquid feeds. In the interim, the requirement to immobilize the liquids will remain in effect both for extended storage of the liquids (the BNPD site license does not permit storage of liquids) and for their incineration. Immobilized liquids may need extended storage if their contact fields exceed the current arbitrary limit of 60 mr/h for acceptable incinerator feeds.

The absorption of two liquid waste streams was examined in this study. The first waste stream consisted of effluent (three drumsful) from a super-compactor campaign conducted at BNPDS in late 1988 while the second waste stream, namely, freon sludge is a routine waste arising (10 m^3 annually) from dry cleaning operations at Bruce. Routine generation of super-compactor effluent will occur in the near future if the planned purchase of a super-compactor materialises. The expected annual arisings of the effluent will then be 6-20 m^3.

The dry cleaning sludge is presently absorbed in " Toxi-Dry" (dry ground corn cob husks) and then incinerated/1/. A similar procedure is required for the super-compactor effluent.

A previous study/2/ examined the capacities of three absorbents, namely, vermiculite, sawdust and Sorbent C for the absorption of oily organic liquids. Sawdust among the three matrices was found

to have the highest capacity for absorbing vacuum pump oil (Endurance 46) and insulating oil (Terresso 32). The capacity ranged between 0.45 and 0.52 ml oil per ml sawdust or equivalently between 2.3 and 3.2 g oil per g sawdust. The use of sawdust is also favoured due to its relatively low cost and low ash content when incinerated/3/.

Based on the above, sawdust was considered to be a suitable host for absorbing supercompactor effluent and as an alternative to Toxi-Dry for the dry cleaning sludge. Its capacity for both liquids was determined in this study; as well, appropriate means for absorbing the liquids were investigated. A radio-chemical characterization of the super-compactor effluent was also performed. The dry cleaning sludge has previously been characterized/4/ and although the results may not necessarily apply to the present waste, no attempt was made to re-characterize it.

2.0 CHARACTERIZATION OF SUPER-COMPACTOR EFFLUENT

One litre samples from the top, middle and bottom of Drums 1 & 2 as well as a one litre sample possibly from the top or middle of Drum 3 were received from BNPDS for analysis. The Drums 1 & 2 samples were aqueous while the Drum 3 sample was oily. All samples were gamma scanned and also analyzed for tritium and C-14. The aqueous samples were analyzed for metals using a number of techniques (x-ray fluorescence, atomic absorption and neutron activation) to assess whether they could be drained into the Active Liquid Waste Treatment System.

X-ray fluorescence indicated that the major elements present in the aqueous samples were sulfur and calcium; magnesium, silicon, potassium, chlorine, phosphorus and aluminium were the other elements detected. The analytical results are summarised in Table 1 below. Where the results for the three samples from each drum differed significantly all the three results are tabulated in the order (top, middle, bottom); otherwise, an average value is reported.

The low solids loading combined with the absence of any significant content of toxic metals suggests that the aqueous effluent can be routed to the Active Liquid Waste Treatment System at Bruce A/5/. The Drum 3 contents would require to be suitably immobilized and thereafter incinerated or stored.

3.0 ABSORPTION OF SUPER-COMPACTOR EFFLUENT AND FREON SLUDGE ON SAWDUST

The capacity of sawdust in absorbing super-compactor effluent and freon sludge was determined and the factors affecting the absorption process were investigated. The latter included 1) the effect of container size, 2) effect of flow rate, 3) effect of

time on absorption, etc. The capacity was determined by adding the liquid to a batch of tamped sawdust in a graduated glass cylinder until the sawdust was completely wetted, compressing the wetted sawdust with a screen followed by removal and measurement of the excess oil. Larger batches up to 10 L were then prepared on the basis of this measured capacity and the effect of scale-up, if any, noted. Experiments were performed using 'as is' sawdust, a medium size fraction (passed screen #10 but retained on screen #12) and a fine size fraction (passed screen #12). The bulk density of the sawdust in all cases averaged 0.22 g/cc.

TABLE 1

ANALYTICAL RESULTS FOR THE SUPER-COMPACTOR EFFLUENT

ANALYTE		DRUM 1	DRUM 2	DRUM 3
Sp.Gravity		1.0	1.0	0.85
pH		7.0	7.6	-
Conductivity	(mS/m)	125	167	-
TSS	(ppm)	<5, 1164, 7	75, 224, 8	-
TDS	(mg/L)	662	697	-
TOC	(ppm)	5, 60, 5	5	-
H-3	(mCi/L)	4.4E-04	0.19	55
C-14	(nCi/L)	<5	<5	<5
Co-60	(nCi/L)	0.58,0.44,<0.06	0, 0.44, 0.47	0
Cs-137	(nCi/L)	0.17	0.05, 0.18, 0	0.53
Arsenic	(ppb)	<20	<20	-
Selenium	(ppb)	<20	<20	-
Mercury	(ppb)	<1	<1	-
Lead	(ppb)	<5	<5	-
Cadmium	(ppb)	<0.2, 0.5, <0.2	<0.2	-
Silver	(ppb)	<0.2	<0.2	-
Chromium	(ppb)	<50	<50	-
Barium	(ppb)	<1	<1	-
Uranium	(ppb)	<0.05	<0.05	<0.8
PCB	(ppm)	-	-	<2

- , Not Applicable or Not Measured
TSS, Total Suspended Solids
TDS, Total Dissolved Solids
TOC, Total Organic Carbon

3.1 Super-Compactor Effluent

While the sample of Drum 3 liquid analysed and reported in Table 1 was an oil sample, a 25 L batch of the effluent subsequently received from BNPDS was a two phase oil-water mixture with essentially similar phase volumes. Clearly, the earlier analysis sample had been drawn from the upper lighter oil fraction in the drum. Only the oil fraction which had a density of 0.85 g/cc was used in the absorption studies; in a few cases the inadvertent presence of water caused the density of the liquid to be higher (0.92 g/cc). The results of the absorption studies are given in Table 2.

The results indicated that the absorption capacity was not significantly affected by the size fraction of the sawdust or by scale-up; the capacity was nominally 2.5 g oil/g or 0.55 g oil/mL of sawdust. Note that in general the volume of the wetted sawdust was lower than the corresponding dry sawdust; this indicates that the oil did not swell the sawdust but essentially wets its surface and occupies the interstitial voids.

Several of the above samples on prolonged standing were observed to develop a relatively dry band on the upper portion of the

TABLE 2

ABSORPTION CAPACITY OF SUPER-COMPACTOR EFFLUENT

Sawdust Type	Volume (mL)			Absorption Capacity			
	Sawdust	Oil	Final	g oil/g	SD	g oil/mL	SD
fine	50	31	42	2.4		0.53	
fine	113	75	101	2.5		0.57	
fine	268	170	233	2.5		0.54	
fine	550	340	414	2.4		0.53	
fine	595	375	544	2.4		0.54	
medium	46	26	35	2.4		0.47	
medium	131	79	106	2.5		0.49	
medium	250	151	232	2.3		0.51	
medium	520	315	464	2.3		0.51	
as is	5000	3100	5000	2.6		0.57	

container while the bottom appeared to retain its wet appearance. Drainage of the oil was suspected and consequently additional experiments were performed where any oil drained from batches of oil-soaked sawdust was collected and its volume measured. Accounting for drainage reduced the oil capacity from 2.5 to 1.9

g oil/g or equivalently from 0.55 to 0.42 g oil/mL of sawdust. These values are similar to those determined earlier/2/.

Experiments were also performed using the "as is" oil/ water mixture from Drum 3. Interestingly, the drained mixture collected in these cases had a similar ratio between the two phases as that in the feedstock. This clearly indicates along with the absence of swelling that the sawdust is merely wetted by the liquid be it oil or water and does not manifest properties of a typical absorber. This conclusion is, however, at odds with the absence of a dependence of the capacity on the size fraction of the sawdust.

Options for contacting the oil with the sawdust were explored. The oil may either be distributed on top of the sawdust or be fed at the bottom using tubes inserted through the bed of sawdust thus causing the liquid to fill up from the bottom. Spillage could occur in the first option due to the rate of filling exceeding the rate of absorption. The second option was thus preferred. However, the introduction of the oil from the bottom up often caused the uppermost layer of the sawdust to remain dry with possibly a pool of unsoaked liquid remaining at the bottom. In such cases, inversion of the sealed containers appeared to adequately redistribute the pool of liquid. Although flow rate would be an important process variable in the first option, it is of no consequence in the second option and this was verified.

The effect of vibration on the release of absorbed oil was explored using a table top shaker for smaller samples and the seismic table in Mechanical Research for a 5 L sample. No release was observed.

3.2 Dry Cleaning Freon Sludge

Results of freon sludge absorption are given in Table 3. The density of the sludge was 1.15 g/ml; note that this value is significantly higher than that reported (1.01 g/ml) in the earlier characterization/4/ and may be due to improved freon recovery from the sludge. As in the case of the super-compactor effluent, absorption of the sludge on sawdust led to an overall shrinkage in volume. The average capacity of the sawdust was 3.0 g oil/g or 0.57 g oil/ml. When drainage was accounted for, the capacity was significantly lowered to 1.5 g oil/g or 0.33 g oil/ml.

4.0 INCINERATION OF ABSORBED SAWDUST

The super-compactor effluent and the freon sludge after absorption on sawdust would be fed into the incinerator for volume reduction. To assess the behaviour of these feeds in the incinerator, preweighed samples of the absorbed materials were exposed in a muffle furnace for a prolonged duration at up to 550

deg. C. The ashes in both cases had a dark brown appearance and were friable. In the case of sawdust loaded with super-compactor effluent, the amount of ash was about 8 wt % while in the case of sawdust loaded with freon sludge, it was approximately 22 wt % ; the higher ash content in the case of freon sludge may be due to its higher loading of suspended solids (possibily ~ 5 g/L/4/). The unexpectedly high ash content obtained in both cases, while undesirable, may not be of any significant consequence unless the waste volumes involved are large.

TABLE 3

ABSORPTION CAPACITY FOR FREON SLUDGE

Sawdust Type	Volume (mL)			Absorption Capacity	
	Sawdust	Freon	Final	g oil/g SD	g oil/mL SD
fine	50	33	41	3.7	0.68
fine	250	150	204	3.3	0.66
fine	500	300	488	3.1	0.63
fine	880	400	679	2.7	0.51
medium	500	280	418	2.6	0.47
medium	1000	400	724	2.5	0.42
as is	6000	3800	4800	3.2	0.62

5.0 CONCLUSIONS AND RECOMMENDATIONS

The aqueous super-compactor effluent had negligible solids loading and as such can be routed to the Active Liquid Waste Treatment System at Bruce A. On the other hand, the oily effluent from super-compaction requires to be immobilised as a minimum.

In general, since the compositions of the super-compactor effluents depend on the waste being super-compacted, there is no assurance that future aqueous waste arisings from this source can always be directed to Bruce A for treatment. A simple procedure, not requiring such extensive analysis as performed here, should be developed to facilitate rapid decision making regarding disposal of the effluents.

Sawdust appears to be adequate as an absorbent for feeding both super-compactor effluent and freon sludge in to the incinerator. However, due to its poor capacity compared with other media such as Dow imbiber beads which can absorb several times their own volume of oil, its use as an absorber for extended storage of the liquids may not be cost-effective.

An appropriate manifold would be required to allow the waste liquids to be introduced at the bottom of a sawdust-filled container. To ensure absence of liquid pools in the container, it is recommended that excess sawdust be used as "top up" in the container and that the sealed containers be stored in an inverted configuration to facilitate even distribution of the oil.

6.0 ACKNOWLEDGEMENTS

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